Mathematics Toolkit: Grade 6 Objective 3.C.1.c

Standard 3.0 Knowledge of Measurement

Topic C. Applications in Measurement

Indicator 1. Estimate and apply measurement formulas

Objective c. Estimate and determine the area of a composite figure

Assessment Limits:

Use composite figures with no more than four polygons (triangles or rectangles) and whole number dimensions (0 – 500)

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Clarification

Mathematics Grade 6 Objective 3.C.1.c Assessment Limit 1

A composite figure is a geometric shape made up of more than one polygon or plane figure. Typically, any line segments shared by the polygons in a composite figure are not drawn. In figure ABCDE below, $\overline{DF}$ is shared by rectangle ABCF and triangle FDE and therefore is not drawn. Students should have opportunities to compose and decompose geometric figures by manipulating polygons (rectangles and triangles). The more that students work on seeing the individual polygons that make up composite figures, the better they will understand how to determine their areas.
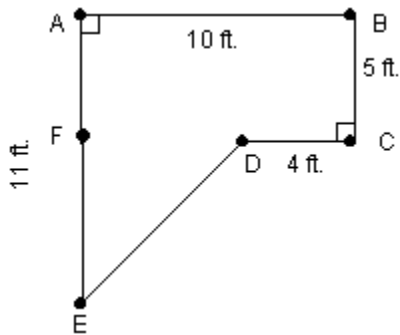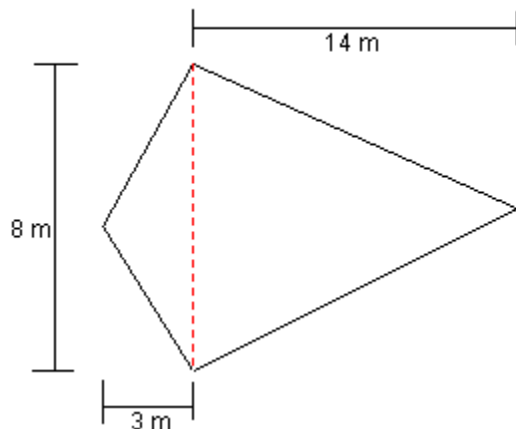

Classroom Example 1

This figure is a rectangle and a triangle combined together. So the area is:

$$A = lw + \tfrac{1}{2}bh$$
$$= (10)(5) + \tfrac{1}{2}(6)$$
$$= 50 + 18$$
$$= 68$$

The area of the figure is 68 square feet.

Classroom Example 2

This composite figure is two triangles combined together. A line segment is drawn that would not normally be seen so that you may see the shared side. The area is:

$$A = \frac{1}{2}bh + \frac{1}{2}bh$$
$$= \frac{1}{2}(8)(14) + \frac{1}{2}(3)(8)$$
$$= 56 + 12$$
$$= 68$$

The area of the figure is 68 m².

Classroom Example 3

One way to help students see the pieces that make up composite figures is a great puzzle called tangrams. The puzzle consists of seven tangram pieces — a square, 5 triangles, and a parallelogram. The tangram is shown below. One goal of the puzzle is to recreate composite figures like everyday common objects and animals using all seven pieces. This teaches students to look for polygons in a composite figure. Once they see how the pieces are related by shape and size, finding the area of a composite figure will be simpler for them.
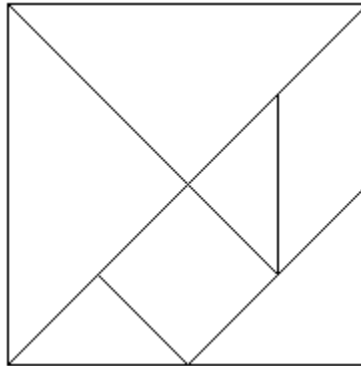
When you look at the tangram, these are the different pieces that make up the puzzle.
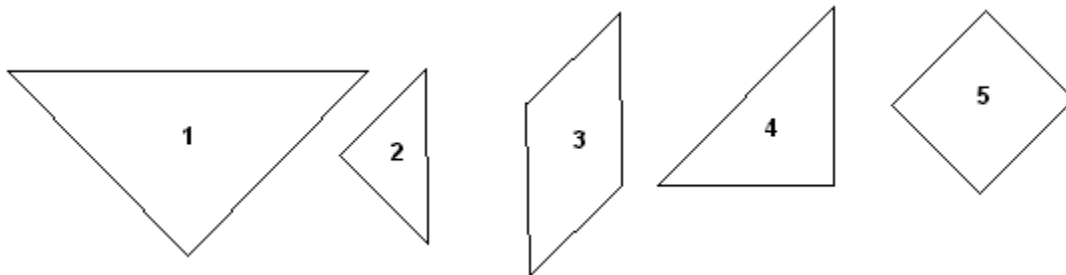
In each puzzle there are two parts 1 and 2 and one each of parts 3, 4, and 5.

- Suppose we let part 2 have an area of 1 sq. unit. Determine the area of each of the other pieces.

    Answer: Part 1 has an area of 4 sq. units, part 3 has an area of 2 sq. units, part 4 has an area of 2 sq. units and part 5 has an area of 2 sq. units.

- If part 2 has an area of 4 sq. units, what is the area of the original puzzle with all seven pieces?

    Answer: 16 sq. units

Suggested resource: The Fun with Tangrams Kit, Susan Johnston, Dover Publications.

Lesson Seeds

Mathematics Grade 6 Objective 3.C.1.c Assessment Limit 1

Materials needed

A class set of composite figures made up of tangram shapes

Activities

- Model the concept of a composite figure using a familiar drawing such as the floor plan of a house with an attached garage. The basic shape of the house can be a rectangle and the garage can be a square.
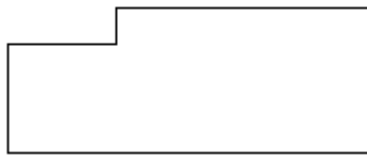
- Tell students they are to determine the area of the house plan shown. Ask students how they would begin to solve the problem. They should tell you that the figure needs to be broken into polygonal parts. The polygons that make up the figure will be rectangles and/or triangles. These are polygons whose area formulas have been developed.
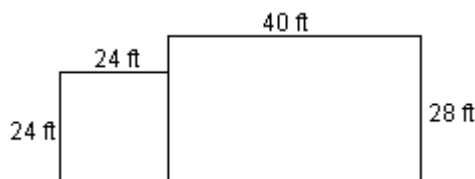
- Then use some of the composite figures from tangrams (described in the clarification example) and have the students determine the polygons' dimensions using the dimension of the small triangle.
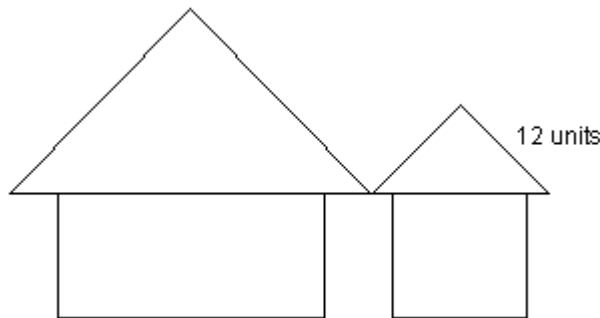
- Model how you would structure the problem before allowing students to find the area. Elicit from them the steps that need to occur before they can determine the area of the composite figure. Many students will find they understand the concept perfectly, but will make a mistake in organizing the problem on paper.

  - Label/number each figure that makes up the composite figure.

- Label the dimensions of the sides needed to find the area of each figure with the measure determined using the side of the small triangle.
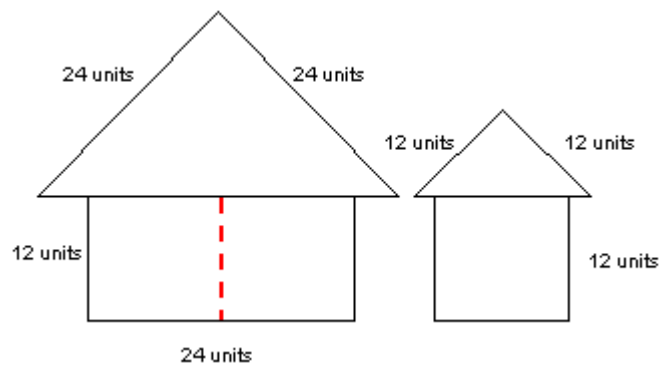

- Determine the area of each figure that makes up the composite figure.

- Now have students find the total area of the composite figure by adding the area of all the polygons. Basic polygons can be used for this activity, but tangram pieces are all related so that all you have to do is provide one dimension of one figure to find the dimensions of all the other figures.
- Each student can then make a tangram drawing that resembles an object. They should remove the shared line segments. Students will then calculate the areas of each other's composite figures.

Higher Order Thinking Skills

Mathematics Grade 6 Objective 3.C.1.c Assessment Limit 1

Level 1: Knowledge/Comprehension
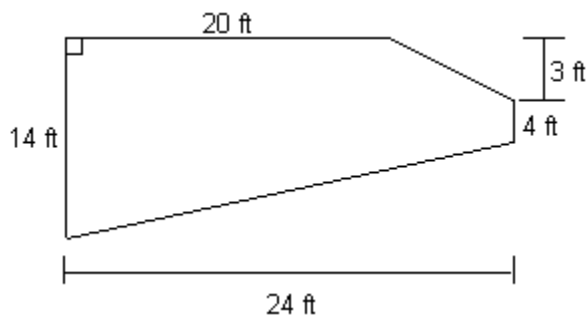
Determine the area of the figure below.
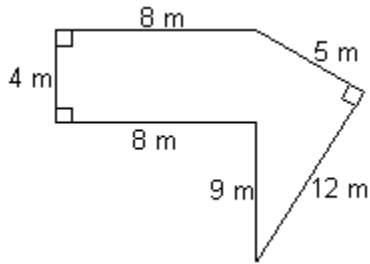
Sample correct response:

$$A = lw + \frac{1}{2} bh$$

$$= (8)(4) + \frac{1}{2}(12)(5)$$
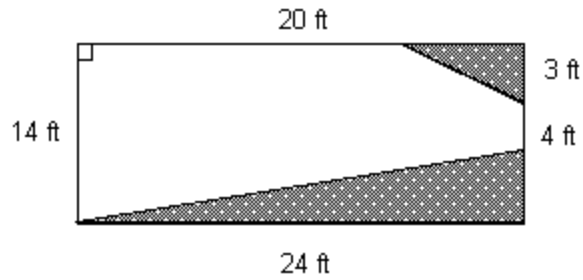
$$= 32 + 30$$

$$= 62 \text{ m}^2$$

Level 2: Application/Analysis

Determine the area of the figure below. You may compose or decompose figures to determine the area.

Method 1: Decomposing
Surround the figure (pentagon) with a rectangle and subtract the area of the triangles to find the area of the pentagon.
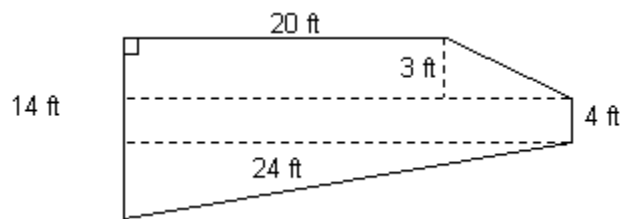
20 ft

3 ft

14 ft

4 ft

24 ft

Sample correct response:

$$A = lw - \frac{1}{2}bh - \frac{1}{2}bh$$
$$= (24)(14) - \frac{1}{2}(24)(7) - \frac{1}{2}(3)(4)$$
$$= 336 - 84 - 6 = 246 \text{ ft}^2$$

Method 2: Composing
Determine which polygons compose the figure. Break the pentagon into two triangles and two rectangles.

20 ft

3 ft

14 ft

4 ft

24 ft

Sample correct response:

$$A = lw + lw + \frac{1}{2}bh + \frac{1}{2}bh$$
$$= (20)(3) + (24)(4) + \frac{1}{2}(3)(4) + \frac{1}{2}(24)(7)$$
$$= 60 + 96 + 6 + 84 = 246 \text{ ft}^2$$

Level 3: Synthesis/Evaluation

Create a figure that has an area of 88 square feet and is composed of a square, a rectangle, and a triangle.
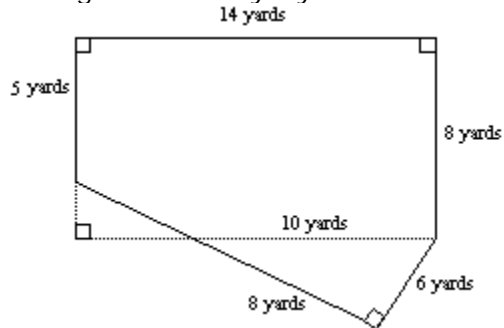
Sample correct response:

12 ft

4 ft

4 ft

16 ft

6 ft
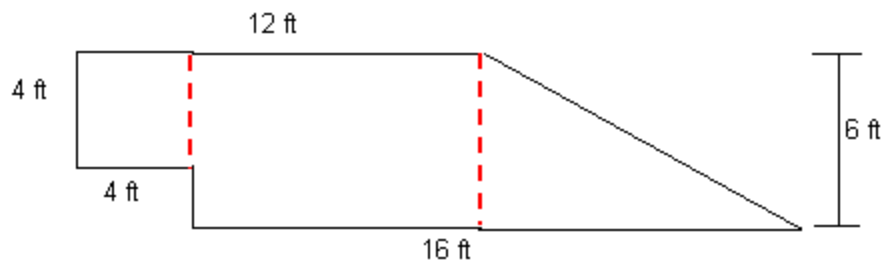
$$\text{Area} = (4)\,(4) + (6)\,(8) + \frac{1}{2}\,(6)\,(8)$$
$$= 16 + 48 + 24$$
$$= 88 \text{ ft}^2$$

Sample Item #1 - Selected Response (SR) Item

Mathematics Grade 6 Objective 3.C.1.c

A diagram of Marty's yard is shown below.

Note: The figure is not drawn to scale.

What is the area, in square yards, of Marty's yard?

      A. 106 square yards
      B. 112 square yards
      C. 130 square yards
      D. 136 square yards

Correct Answer:
C